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Space Station Human Productivity Study

FINAL REPORT VOLUME IV ISSUES

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BY

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INTRODUCTION

The 305 Issues contained in this volume represent topics recommended for study in order to develop requirements in support of Space Station crew performance/productivity. The process by which these Issues were developed is described in Volume I. One hundred eight of these Issues were selected and topically grouped to prepare 67 study Management Plans, which are contained in Volume V.

The overall subject matter, Space Station elements affecting crew productivity, was organized into a coded Subelement listing, which is included in this volume for the reader's reference. Each Issue is numbered according to that 5-digit topical coding scheme. Multiple Issues within a Subelement (topic) are sequentially numbered, forming a 7-digit Issue number. The first digit corresponds to one of five element Groups. Groups 1 through 4 are IVA specific; Group 5 elements relate to IVA/EVA Interface.

Because it was not possible to complete and fully integrate these study results with those of the Advanced EVA Systems studies (refer to Volume I) all Group 5 Issues are "Preliminary", and are so marked.

The Requirements column on each Issue page shows a cross-reference to the unresolved requirement statement(s) (sometimes omitted) contained in Volume III, correspondingly organized by the same Subelement number - unless otherwise noted.

Because topical overlaps were frequently encountered, many initial Issues were consolidated to form this final set. Apparent gaps, therefore, may be accounted for by an Issue described within a related Subelement.

A glossary of abbreviations used throughout the study documentation is also included.

The complete set of Volumes for the Human Productivity Final Report are:

Volume I	-	Final Report (Study Description)
Volume II	-	Executive Summary (and Oral Review)
Volume III	-	Requirements
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Volume V	-	Management Plans

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ELEMENT
SUBELEMENT)

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* IVA Subelements having Requirements and Issues of concern to EVA Systems.

** Requirements generated by Advanced EVA Systems Design Requirement Study.

GLOSSARY

ACGIH	American Conference of Government & Industry Hygienists
AF	Air Force
AI	Articulation Index
ANSI	American National Standard Institute
ASE	airborne support equipment
ATAC	Advanced Technical Advisory Committee
BP	blood pressure
C	centigrade
C&T	communications & tracking
CAD	computer aided design
CCTV	closed circuit television
CDG	Configuration Design Guidelines
CO2	carbon dioxide
CRT	cathode ray tube (TV screen)
CSD	contract start date
CVD	cardiovascular deconditioning
db	decibels
dBA	decibel, A scale
dBc	decibel, C scale
DBMS	database management system
E-Field	electric field
ECG	electrocardiogram
ECLS	environment control life support
ECLSS	environmental control & life-support system
EEU	extravehicular excursion units
EL	electro-luminescent
EM	electromagnetic
EMI	electromagnetic interference
EMU	extravehicular mobility unit
EVA	extravehicular activity
F	fahrenheit
Ft-C	foot candles
Ft-L	foot lamberts
+GZ	positive acceleration gravity vector, head to foot (least tolerance)
H-Field	magnetic field
H2O	water
HEPA	high efficiency particulate air
HMF	health maintenance facility
HMS	habitability manned system
HOL	higher-order language
HPD	hearing protection device
hr	hour
HR	heart rate
HZ	hertz
HZE	high energy Z particles
IDMS	Space Station information & data management system
IMS	inventory management system
IMSS	in-flight medical support system
IOC	initial operating capability
IR	infra-red
ISO/TC	International Standards Organization/technical circular
IV	intravenous
IVA	intravehicular activity
JSC	Johnson Space Center
k	kilo
K	Kelvin

GLOSSARY

LA	noise level in dBA
LCD	liquid crystal display
LED	light emitting diode
LET	linear energy transfer or ionization rate along particle track
LSRM	Life Sciences Research Module
Leq	equivalent noise level (average over a specified duration)
MDBMS	medical database management system
MIL-STD	military standard
MMU	manned maneuvering unit
MPAC	multipurpose applications console
MSFC	Marshall Space Flight Center
MSIS	Manned Systems Integration Standards
MSS	manned space station
N2	nitrogen
NASA	National Aeronautics & Space Administration
NC	noise criterion curve
NHB	NASA handbook
NOS	Network Operating System
NSTS	national space transportation system (shuttle)
OBL	octave band level
ODD/LDD	observed daily duration noise/limited daily duration noise
ODDNet	optical data distribution network
ORU	orbital replacement unit
PI	principal investigator
RF	radio frequency
RFP	Request for Proposal (9-BF-10-4-01P, Space Station Definition and Preliminary Design, 15 Sept 84)
SDP	subsystem data processor
SIL	speech interference level
SMS	space motion sickness
SOMS-A	shuttle on-board medical system, A modification
SSP	Space Station Program
SSPE's	Space Station program elements
STS	Space Transportation System
Specs	specifications
TBD	to be determined
TV	television
UV	ultra-violet
WMS	waste management system

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

10102

ACTIVITY VOLUME PER CREWMEMBER/FUNCTION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1010201	MINIMUM ACTIVITY AREA VOLUME REQTS. Existing guidelines for volume allocation assume 1-G; further studies are needed to develop volume/activity area guidelines for the micro-g environments for all areas of the station. Study to include consideration of translation, inter-personnel, work and habitability effects. Include contingency EMU operations requirements.	-01,-06

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SUBELEMENT #TITLE

10104

DEDICATED VS MULTIPURPOSE SPACE UTILIZATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1010401	MULTI-USE VS DEDICATED SPACE CRITERIA Research is needed to develop valid engineering & operational criteria that can be used in establishing an optimal balance between requirements for multi-purpose vs dedicated activity areas. Additionally, significant increase in crew size due to growth requirements may change the optimal balance in these areas relative to its space utilization & functionalities. Thus a compartmentalization/mission duration relationship guidelines is also needed.	-05

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
10107

TITLE
PHYSICAL/FUNCTIONAL ADJACENCIES

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1010701	<p>COMPARTMENT/AREA ADJACENCY CRITERIA</p> <p>An important consideration in the geometric arrangement of compartments is its relationship with adjacent activity compartments & areas. A key consideration in the layout design is the size, configuration, & functions of equipment & furnishings which impact adjacency considerations. Thus requirements are needed to determine the optimum relationships between the various activity areas &, hence, adjacency priorities, also, furnishing requirements for long duration micro-g environment. (Oct 85)</p>	-01

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

10108

INTER/INTRA-MODULE EQUIPMENT ORIENTATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1010801	<p>MODULE/ACTIVITY AREA ORIENT'N STANDARD</p> <p>Optimum space/volume utilization for equip. orientation vs a 1-g orientation is an issue to be resolved. Differing orientation between modules or activity areas enhances volume utilization but disturbs crew members. Study is needed to evolve specific crew disorientation criteria to allow trade-offs so that space utilization can be maximized and to trade-off against the stated Phase B requirement that intra-module doors/hatches will not require body reorientation.</p>	-01

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

10109

TITLE

GROWTH

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1010901	EXPANDED VS REDUNDANT FACILITIES Study is needed to trade the options of increasing the capacity, capability and/or size of specific activity areas vs adding a second or backup activity area to accommodate growth, e.g., maintenance workshop; galley/wardroom; medical care; exercise area, etc.	-03

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

10201

FREQUENCY OF TRANSIT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1020101	TRAFFIC FREQUENCY DETERMINATION Optimization of interior architecture eg, passage, adjacencies, space/ clearances, is dependent in part on frequency of crew member translation between activity areas. Normally deter- mined by contractor (based on mission, function, task analysis) multiple con- tractor analyses may cause differing results. It is more efficient to unify this analysis to develop standard design criteria.	-01

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
10202

TITLE
EQUIPMENT ACCOMMODATIONS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1020201	EVA ORU MAINTENANCE ACCOMODATIONS RQMTS EVA ORU maintenance requirements will impact passage design, eg, equipment size, frequency of handling, type of equipment & related handling require- ments. IVA study must coordinate with EVA study to evolve requirements for interior design (exclusive of main- tenance or servicing facility) and related handling aids.	-01

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
10203

TITLE
CONGESTION MINIMIZATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1020301	<p>WORKSTATION LOCATIONS CRITERIA</p> <p>Limited module interior volume & module-to-module interface reduce design options re: traffic corridor location & isolation/separation of the many & varied workstation throughout the space station. Individual workstations should be examined in terms of the tasks to be performed to assess workstation/traffic path separation requirements. Tradeoff studies should then be performed to evaluate alternative workstation locations in light of Human Productivity, safety, traffic congestion, & design/cost impact considerations.</p>	-01

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
10204

TITLE
PASSAGE IMPINGEMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1020401	MAXIMUM HATCH SIZE Study to establish a standard practical hatch size is needed. Trade study concerns include practical design constraints, pass-through requirements of maximum ORU sizes and handling & clearances. Determine feasibility of single vs multiple-application standards.	-07

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PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

10301

COLOR, TEXTURE, GRAPHICS & LIGHTING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
=====	=====	=====
1030101	INTERIOR DESIGN GUIDELINES	-01
	Studies are needed to evaluate technical aesthetics & develop a set of design guidelines which can be utilized in space station interior design. Consideration should be given to the unique perceptual/physical changes that occur to crew members in micro-g. Also user population i.e., international crew accommodation. In addition, use of Fed Std 595 is overly restrictive. Alternate sources/standards should be developed to achieve desired impacts.	

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
10302

TITLE
INTERIOR DESIGN MODIFIABILITY

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1030201	INTERIOR DESIGN MODIFIABILITY PROVISIONS The extent to which interior decor provisions will be made modifiable could have a major impact upon module internal layout & design, as well as upon cost, access & spares provisioning factors. An assessment of benefits should be traded against modification techniques, extent and impact.	-01

SUBELEMENT #
10303

TITLE
CODING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1030301	COLOR, LABEL, & PATTERN CODING CRITERIA Color, graphic, texture, labeling in support of identification, location & orientation within the space station may be overly comprehensive. Overuse, conflict with area decor goals, accommodation of various nationalities/languages/modifiability, graphic vs verbal symbology, information overload, etc. should be examined to evolve standards/requirements which ensure that coding enhances, rather than detracts from human productivity.	-10
1030302	INTERIOR LOCATION COORDINATE SYSTEM Specifying location points within/out the station (as stated in RFP) may be inordinately difficult to implement in light of station complexity, modification/reconfiguration activities, and incremental growth. The need to track configuration changes & update associated schematics (i.e., software, drawings) may also present costly design/operational challenges. Feasibility study is needed.	-04

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PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
10400

TITLE
GENERAL

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
=====	=====	=====
1040001	HAB INTERIOR MATERIALS SELECTION RQMTS Materials selection & use criteria to establish acceptability & suitability, extended life, technological maturity, manufacturability, inspectability, contamination characteristics, specific strength, compatibility, availability, cost & safety.	--01

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
10402

TITLE
MAINTENANCE AND REPAIR

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1040201	ACCESS FOR PRESSURE LEAK REPAIR Interior design and clearances are for shirt-sleeve, pressurized access. In case of pressure leak access for repair may require use of EVA Suited access. Study needed for design impact regarding access schemes. Feasibility trade is needed for alternative approaches, in- cluding possible module replacement.	-03

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
10502

TITLE
RANGE OF ACCOMMODATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1050201	ANTHROPOMETRIC RANGE ACCOMMODATIONS Accommodation of the full range of anthropometric limits (adjusted for 0-g adaptation) specified might create substantial design challenges within the volume constraints imposed by the Space Station modules. The range may be considerably extended by need to accommodate an international population. Definition of extent of international participation may be needed. Consideration should be given to the advisability/impact of delimiting those ranges and/or developing design approaches which emphasize adjustability flexibility & modularity.	-01,-02,-03, 10501-01

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

10503

PHYSICAL DIMENSIONS & LIMITS IN MICRO-G

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1050301	NEUTRAL BODY POSTURE DATA DEVELOPMENT Definitive data relative to the impact of the neutral body posture & micro-g upon the full range of anthropometric limits for the international, mixed sex user population has not been adequately developed. Complicating the matter is the fact that human anthropometric limits have been found to change as a function of time on orbit. Additional data is needed to assess the impact of 30-year growth trends upon micro-g anthropometry.	-03

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
10504

TITLE
GROWTH

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1050401	GROWTH AND ANTHROPOMETRIC CRITERIA Study is needed to establish baseline year for growth station (beyond year 2000) to assess extrapolations of anthropometric data and applicability to current concepts of present station growth plans. Decision is needed con- cerning impact on scarring requirements.	-01

SUBELEMENT #TITLE

10601 GENERAL

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1060101	INTERIOR VOLUME REARRANGEMENT REQMT. Determine requirements that define how astronauts shall be able to optimize interior volume arrangements to accommodate revised configurations. Determine equipment rack requirements that ensure flexibility to reconfigure in various module configurations.	-01,10603-01
1060102	STANDARD HARDWARE AND INTERFACE REQMTS. Determine the requirements that define how interfaces between primary and secondary structure and between sub-systems and their attachment to structure shall be standardized to minimize human involvement in repair, maintenance, reconfiguration etc. This includes standard electrical/cooling/data bus interfaces. Also included are determination of the commonality design requirements for fasteners, tools, latches, and packaging. Consider the station growth implications.	-02,10603-03, 10607-01,-03

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

10706

WINDOW MAINTENANCE/PROTECTION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1070601	WINDOW MAINTENANCE AND PROTECTION REQMTS The degree of optical degradation due to exposure to ultra violet x-ray radiation, meteroid impacting and/or contamination allowable and the means of cleaning, maintaining, repair and/or replacement and testing requires further study.	-01,-02

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
10901

TITLE
CREW EQUIPMENT STOWAGE

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1090101	STOWAGE CONFIGURATION. Determine volume, layout, design, access, and interchangeability. Consid- erations for stowage, include recrea- tional equipment, crew equipment, galley, logistics module, mission equip- ment, etc., in an integrated manner. Also include restowage of clean clothes, dishes, etc.	-01,-02,-03, -04,-05,-09, -20, 10905-01,-04

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
10902

TITLE
FOOD/GALLEY STOWAGE EQUIPMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1090201	FOOD/GALLEY SHELF STOWAGE REQUIREMENTS Determine food stowage volume requirements and environmental control criteria (eg., temp, humidity). Evaluate stowage location and type, such as freezer, refrigerator; and/or stowage in galley or other locations, eg., logistics module. Determine stowage design requirements, including volume, power, etc.	-02
1090202	FOOD STORAGE TEMP. LIMITS Develop requirements for environmental control of food in storage. Will drive design criteria. Consider volume, food types, packaging, access, etc.	-01

<u>SUBELEMENT #</u>	<u>TITLE</u>
10903	TRASH-WASTE STOWAGE/STORAGE

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
=====	=====	=====
1090301	TRASH-WASTE STOWAGE/STORAGE Determine volume and control require- ments for trash-waste stowage and handling. Develop needs for contami- nation isolation; dry-wet; off-gassing; packaging criteria; hazardous materials Evaluate restowage in provision con- tainers and location needs and/or requirements. Will drive layout, design, location, power & volumes required for internal and external trash, waste storage.	-01,-02,-03

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
10904

TITLE
DATA FILE STOWAGE

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1090401	DATA FILE STOWAGE REQUIREMENTS Determine stowage volume, environmental control, and handling requirements to drive design requirements. Assess material types, protection needs; access, sorting, locations, etc. to drive design alternatives.	-01,-02

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
10906

TITLE
GROWTH

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
1090601	STORAGE VOL. & CONFIG. REQTS FOR GROWTH Assess space/volume allocation needs for growth station storage/stowage require- ments. eg., trade: supply support frequency vs. storage volume; corre- lation - crew size to storage volume; mission types to storage volume; internal/external storage & access. Include all storage - mission, crew provisions, trash, etc. (Jul 87)	-01

SUBELEMENT # TITLE
 20101 ATMOSPHERE REVITALIZATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2010101	ATMOSPHERE SPECIFICATION Prepare a revised atmosphere specification relative to the referenced data. Include determination of minimum levels of atmosphere humidity versus temperature, ventilation rate, and crew comfort. Also include definition of range compounds to be monitored, specification of analytical monitoring instruments to be used for analysis of particulate, organic, and inorganic aerosols and airborne microorganisms.	-02a,-02b

SUBELEMENT # TITLE
20102 WATER MANAGEMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2010201	HYGIENE WATER SPECIFICATIONS Prepare a hygiene, dishwasher, and clotheswasher water quality specifica- tion. Determine total dissolved and suspended solids limits for potable water. Determine optimal temperature ranges for each type of water.	-02a,-02b
2010202	MAINTAIN/TEST POTABLE H2O PURITY Specify compounds to be monitored and analytical instruments and methods to be used.	-02d
2010203	WATER ALLOCATION FOR CREW SUPPORT Determine the water allocations for the dishwasher, clothes washer, shower, etc.	-02c

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
20103

TITLE
CONTAMINATION/ODOR CONTROL

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2010301	GASEOUS CONTAMINANT LOAD MODEL The design of the gaseous contaminant control system is driven by the load model. The model is derived from materials offgassing, metabolic load & vehicle & experiment operations most of which are not well known prior to testing of the final spacecraft.	-01
2010302	MICROBIAL LOAD MODEL Data on long term microbial buildup in spacecraft is not available. Sources of bacterial contamination, type of bacteria to be encountered, degree of proliferation & effects of normal environmental control equipment on removal should be established to define the load model & to support system analyses & trade studies. (rqmt -08)	-08
2010303	CONTAMINATION UNITS LIMITS Establish contamination dose limits for SS environment. Results will drive selection of materials & cleanup criteria e.g, aerosol levels, non-pathogenic bacteria, cleaning agents.	-02,-06,-12

SUBELEMENT # TITLE
 20201 RADIATION - PARTICLES

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2020101	RADIATION MONITORING SYSTEM Performance requirements for radiation dose monitoring systems. How many, what locations, and sensitivity ranges of internal fixed active radiation sensors and the requirements for read-out and data storage? Note that such area monitoring is required by law (10CFR203)	-01, 20202-01, 20203-01
2020102	PERSONNEL DOSIMETRY Performance requirements of personnel dose monitoring system. What radiation types, levels needed for read-out, and what type read-out and data management? Note that personnel monitoring of some kind is required by law (10CFR20.203)	-02
2020103	OPTIMAL SHIELDING DISTRIBUTION What is optimal distribution of radiation shielding mass? On vehicle structure, in equipment, personal shields in/on clothing, chairs, etc.?	-05
2020104	WINDOW RADIATION PROTECTION What attenuation factors are required in windows for ionizing radiation protection? What window materials, what allowable dose rates at window areas, consider trapped particles only. Involves allocation of dose rate requirements to activities in proximity to windows.	-03
2020105	SHIELDED STORAGE How much shielded volume, at what dose rates, is required?	-04
2020106	RADIOLOGICAL TRAINING What is required level of crew radiological training? What curriculum, behavioral objectives, duration, evaluation methods?	-06

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT # TITLE
 20204 HIGH-Z, HIGH-E PARTICLES

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
	HZE PARTICLE MONITORING SYSTEM (Issue included in 2020101)	
2020401	HZE PARTICLE PROTECTION FEASIBILITY Is it feasible or useful to protect crew from HZE particles? To what levels of fractional cell lethality?	-01,-02

SUBELEMENT #TITLE

20205 SOLAR FLARES

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2020501	SOLAR FLARE RISK What is allowable risk due to solar flare radiation? This must be decided, and early on, since solar flare sizes are distributed statistically and risk cannot be zero, although it can be small. Amount/nature of shielding will depend upon the risk that is deemed acceptable. Acceptable probability of radiation illness syndrome probability of late effects - e.g., cancer?	-01
2020502	SOLAR FLARE PROTECTION What is best way to protect crew from solar flare doses? Determine feasibility of safe haven shielded room.	-01
2020503	SOLAR FLARE CONTINGENCY PLANNING How extensive should solar flare contingency planning be?	-02
2020504	SOLAR FLARE WARNING SYSTEM How extensive and reliable should solar flare warning system be?	-02

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT # TITLE
 20208 MICROMETERORITES

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2020801	MICROMETEORITE AND DEBRIS PROTECTION How best to coordinate radiation shield design with micrometeorite and debris shield design. Low-Z materials needed on exterior for electron shields. What commonality exists in protective measures and how to jointly optimize them?	-01

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

20210 GROWTH

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2021001	RAD SHIELDING STRATAGY FOR GROWTH How best to provide growth capability for radiation environment? How con- struct shielding in orbit? Cost trades with different approaches?	-01

PROBLEMS/ISSUE IDENTIFICATION

TITLE

20212 GROUND SUPPORT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2021201	GROUND SUPPORT FOR RADIATION PROTECTION What is optimal division of computation work on radiation monitor data base, orbit changes, contingency planning, failure mode modeling, etc. between on-board and ground computers?	-01,-02

SUBELEMENT # TITLE
20302 ELECTROMAGNETIC

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2030201	EM LEAKAGE SPECIFICATIONS What leakage/stray/scattered/accessible radiation intensities over the entire EM spectrum (3KHz to UV) should be specified for all on-board electronic/ optical equipment?	-03
2030202	RF/MICROWAVE EXPOSURE LEVELS What should be the allowable power density or E-/H-field exposure levels for Space station crew? There is con- siderable controversy, and several sets of standards, by NASA, OSHA, ANSI, DOD, ACGIH, that have differing allowables. Space Station program will not resolve the controversy, but must choose some allowable (maximum) exposure for design.	-01

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

20304 LASER

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2030401	LASER LIGHT PROTECTION OPTIONS What viable alternatives exist for crew eye/skin protection from Space Station laser sources when the mission requires use of high-power lasers which can produce either direct or diffusely scattered radiation in the Space Station? Goggles? Face shields? Curtains? Consider effectiveness and inconvenience of use.	-01

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

20305 GROWTH

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2030501	SYNERGISTIC INDUCED ENVIRON EFFECTS As the Station grows, what syner- gistic effects, e.g., effluents, debris, or radiation, are generated by the proximity of additional modules or systems?	-01

SUBELEMENT #

TITLE

20401 ILLUMINATION & DISTRIBUTION REQMENTS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2040101	PHYSIOLOGICAL EFFECTS OF LIGHT	-03
	Research has indicated that diurnal cycle of melatonin production by the pineal gland is not entrained by ordinary room illumination. Chronic production of melatonin may dispose personnel to mood and behavioral changes via hormonal/neurotransmitter changes. Consideration is needed to evaluate these possibilities to determine their significance and corrective measures, if necessary.	

SUBELEMENT # TITLE
 20501 NOISE CONTROL

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2050101	PREDICTION OF LOW FREQUENCY NOISE Low frequency acoustic energy cannot be transmitted from the Space Station into outer space. Acoustic absorption coefficients of common materials have not been published below 125 Hz, therefore reliable noise predictions cannot be performed at low frequencies. This issue would have an effect on Space Station design.	-04
2050102	LOW FREQUENCY NOISE CONTROL The literature offers no passive low frequency noise control technology which could be used if the Space Station noise level is above limits.	-03d
2050103	ZERO-G EQUIPMENT NOISE STANDARDS Noise emission standards must be set for equipment installed within the Space Station. Noise characteristics of rotating machinery, etc. may have different vibro/acoustics characteristics at zero-g. Included must be development of background noise standards, re: masking enhancement and irritability reduction.	-01,-02, 22002-01, 20505-02

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PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT # TITLE
 20502 PHYSIOLOGICAL EFFECTS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
=====	=====	=====
2050201	LONG DURATION O-G NOISE EXPOSURE LIMITS	-01h,
	No valid noise guidelines exist which	20503-02,-03
	defines safe, habitable limits for	
	continuous, long duration exposure in	
	a confined and weightless environment.	

SUBELEMENT # TITLE
20701 PHYSIOLOGICAL CONDITIONING/COUNTERMEASURES

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2070101	PHYSIOLOGICAL COUNTERMEASURES STDS Quantitative Objectives and goals regarding prevention/ minimizing muscle, bone, cardiovascular deconditioning should be established.	-02
2070102	EXERCISE TIME REQTS Number of hours of exercise per day on existing devices, e.g., treadmill, bicycle ergometer, needs to be established	-03
2070103	ZERO-G AEROBIC EXERCISES Aerobic exercise devices which engage larger muscle masses than treadmills and ergometers should be provided (e.g., cross country skiing trainer vertical climbing simulator).	-07
2070104	ZERO-G SPORTS AND GAMES Aerobic exercises such as sports/games involving two or more crewmembers, should be developed to alleviate the boredom of single person exercises	20903-06, 20906-04, -05
2070105	PHARMACOLOGIC COUNTERMEASURES The use and protocols for fluid/electrolyte and pharmacological cardiovascular countermeasures need to be established	-06
2070106	CUSTOMIZED HEALTH MAINTENANCE PROGRAM Through cooperation with each crewman develop the optimum combination of countermeasure techniques (e.g., exercise, passive G-loading devices, diet, fluids, medication, and time required, including accounting for individual variability, needs to be established.	-07,-08
2070107	SPACE MOTION SICKNESS COUNTERMEASURES Determine validity of, and necessity for, space motion sickness countermeasures such as drugs, autogenic feedback training, etc.	-03,-09
2070108	POLICIES FOR MEDICAL RESEARCH PROTOCOLS Some human research protocols may call for investigation of lean body mass loss, orthostatic intolerance, etc. How much compromise of the countermeasures prescription is acceptable?	20705-03, 20801-01

2070109 | DECREASED CALCIUM ABSORPTION C/M | -02
| The absorption of calcium is influenced |
| by several factors including certain |
| wavelengths of ultraviolet (UV) light, |
| vitamin D levels, and total calcium in- |
| take. The optimum method for compensat- |
| ing for the loss of daily sea level UV |
| radiation should be determined, con- |
| sidering dietary composition, window |
| design, and/or artificial generation of |
| UV light. Other health factors may be |
| influenced by UV radiation and should be |
| examined in this study. |

<u>SUBELEMENT #</u>	<u>TITLE</u>
20702	PHYSIOLOGICAL STATUS MONITORING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2070201	ZERO-G PHYSIOLOGICAL NORMS Physiological normal for certain parameters may be different in space. The appropriate values should be determined for use in evaluating trends and changes in health status.	-02
2070202	PHYSIOLOGICAL RECOVERY RATES The time to attain complete recovery from stressful conditions, e.g., repeated EVA may be altered in space. Recovery time for typical stresses should be determined.	-03
2070203	ROUTINE HEALTH MONITORING REQTS Reqs. should be established as to how frequently and what measurements are taken to determine a crewmember's health status/need for change in C/M prescription.	-01b, -01d

SUBELEMENT # TITLE
20703 DISEASE PREVENTION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2070301	ANIMAL PAYLOADS BIOISOLATION RQMTS The design/operations approach to microbiological isolation of animal holding facilities from the rest of station needs to be established.	-07
2070302	CREW ROTATION - MICROBIOLOGICAL RQMTS The need, or lack thereof, of special bioisolation procedures for use at mission end/crew changeout needs to be established.	-02
2070303	INT'L CREW PREFLIGHT HEALTH RQMTS Guidelines for preflight health stabili- zation program for foreign visitors to Space Station need to be established.	-01,-02
2070304	SICK CREWMEMBER BIOISOLATION RQMTS The design/operations approach to microbiological isolation/quarantine of one or more sick or deceased crew- members be developed.	-06

SUBELEMENT # TITLE
20704 ACCIDENT PREVENTION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2070401	ZERO-G VISUAL PERFORMANCE CHANGES Changes in visual sensitivity and fine motor skills have been hypothesized and/or reported anecdotally; need to establish valid predictors of performance changes.	-01
2070402	CRITICAL TASK PERFORMANCE ASSESSMENT Critical tasks need to be identified. Need to define appropriate psychomotor methodologies for assessing the crew's performance of these tasks during training. Need to determine whether or not these assessment techniques are required on-orbit.	-03

SUBELEMENT # TITLE
20705 STRESS MANAGEMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2070501	STRESS LEVEL DETERMINATION In cooperation with crew, determine best configuration of systems for monitoring crew's stress levels.	-03,-09
2070502	STRESS FACTORS DEFINITION Identify or develop physiological and psychological predictors of performance under stress.	-06
2070503	STRESS CONTROL TECHNIQUES Perform trade analysis between biofeed- back, drugs, and other techniques to re- duce symptoms of both chronic and acute stress.	-09
2070504	STRESS REDUCING MEDICATIONS Determine how reactivity to drugs changes as body adapts to space. Establish norms or dosage and usage levels.	-03,-08
2070505	CHRONIC STRESS DIET REQUIREMENTS Identify the unique nutritional require- ments stemming from long-term stress. Develop norms for crew diet.	-02
	STRESS ARISING FROM FAMILY (See 2090401)	

SUBELEMENT # TITLE
 20801 DIAGNOSIS & TREATMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2080101	ROUTINE MEDICATION GUIDELINES New guidelines for self-diagnosis and prescription may be needed in context of station's organization and autonomy structure.	-01a, -06a
2080102	ZERO-G MEDICATION PRECAUTIONS Doses and expected results of drugs in the HMF pharmacopia should be understood in relation to individual attributes and stay-time in micro-g.	-03b
2080103	X-RAY AND ALTERNATIVE IMAGING SYSTEMS The selection of the medical imaging system will require an assessment of '80's state-of-the-art and trade-off of diagnostic capabilities vs. station resources.	-01a
2080104	DEFINITION OF ACCEPTABLE MEDICAL RISK - The decision not to include certain emergency DX/RX capabilities should be based on analysis of probability of occurrence and establishment of acceptable risk.	-04b
2080105	ONBOARD MEDICAL CAPABILITY REQTS Definition of equipment and facilities will involve a series of trades related to cost, mission resources, probability of occurrence and other factors	-01a
2080106	PARA-MEDICAL SKILLS DEFINITION Definition of the minimum skill level of a (non-physician) medical specialist crewmember should be established.	-05a
2080107	MED HANDLING OF RADIATION EMERGENCY Determine the feasibility of medical treatment for radiation effects after exposure.	-03b
2080108	MED HANDLING OF PSYCHIATRIC EMERGENCY Procedures and equipment/facilities for use in the event of a psychiatric emergency should be considered.	-03b
2080109	CRITERIA FOR ONBOARD PHYSICIAN Crew size and other factors which require that physician presence is mandatory needs to be established, consid-	-03b

lating definition of acceptable medical :
risk criteria. (Ref. Issue 2080201) :

<u>SUBELEMENT #</u>	<u>TITLE</u>
20804	MEDICAL RECORDS, COMM, & INFO MGMT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2080401	MEDICAL EXPERT SYSTEM DEVELOPMENT An automated diagnostic and treatment expert system should be developed.	-04
2080402	RULES FOR USE OF MEDICAL EXPERT SYSTEM The criteria for non-physician use of medical expert system should be established.	-05
2080403	MED DATA BASE MGMT SYS REQMTS. System architecture, core memory size, a type of mass storage memory of the Medical Data Base Mgmt System needs to be established.	-02

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT # TITLE
 20805 GROWTH

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
=====	=====	=====
2080501	DIAGNOSTIC CAPABILITY CRITERIA - GROWTH Augmented diagnostic capability should be evaluated against crew size/ characteristics, mission content/ duration, increased risk, and other factors.	-01
2080502	TREATMENT CAPABILITY CRITERIA - GROWTH Augmented treatment capability, e.g., onboard surgical capability, should be reevaluated with changes in crew size/ composition, mission duration/complexity, increased risk, and other factors.	-02

SUBELEMENT #TITLE

20901 TYPES

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2090101	INDIVIDUAL RECREATIONAL PREFERENCES Determine types of crew recreational preferences. Determine methods to evaluate crew preferences during flight. Devise system to accommodate prior to and during flight requests. Determine methods for identifying varied tastes and preference of crews containing nationals of other countries and people from different cultures and subcultures and the effect of such varied values and customs small groups and in terms of the specific mix of a given crew. Can changing recreational preferences be accommodated? What ways, if any, to tell how leisure needs and wants change over time? Develop systems and standards to determine the types of changes in leisure activities areas related to changes in crew size and mix. Determine time needed/wanted for individual and group activities.	-03,-06 20906-01,-11,-12 -07,20906-07 20907-02 20906-02
2090102	O-G REC ACTIVITIES, EQUIPMENT & MATLS. Determine the types of equipment and material which are suited to (or which can be modified to) the O-g environment. Determine what connotes minimal recreational equipment. Determine what equipment and materials are suitable for individual and small group use. Determine an efficient, easy-to-use way to store recreational equipment. Determine a storage area with easy access and adequate restraints.	20906-08,-04,-05,20903-06,-05 20907-01 20906-09

SUBELEMENT #TITLE

20902 FACILITIES

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2090201	FACILITY FOR GROUP RECREATION Determine various methods of providing space for the entire group to meet and participate in activities together (i.e. examine the amount of volume required and possible methods of providing volume, such as modularization of walls, etc.) Determine how facilities will be enlarged as crew size grows.	-07,-11 20907-01
2090202	FACILITY FOR INDIVIDUALIZED RECREATION Determine where and how this should be structured. Determine where and how a private TV area should be structured.	-08 -10

SUBELEMENT #TITLE

20903 EQUIPMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
	MINIMUM LEISURE EQUIPMENT/SMALL GROUP RECREATION EQUIPMENT REQUIREMENT (Issue included in 2090102)	-01,-05
2090301	OFF-SHELF RECREATIONAL EQUIPMENT Determine what equipment and materials need to be specially designed and what can be purchased or supplied by crew- members.	-06
2090302	INNOVATIVE RECREATIONAL PROVISIONS Determine non-dedicated supplies and materials which might be used in many ways.	-07,20906-10, -06

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

20904 SUPPORT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2090401	GROUND NEWS DISSEMINATION Determine who will determine and what criteria and system to be used in determining what news, family emergency information, etc., shall be transmitted to crews in flight.	-01

SUBELEMENT #

TITLE

20905 CRITERIA

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2090501	RECREATION OBJECTIVES Determine those activities most conducive to improving mental health and reducing boredom, lethargy, etc. Determine those activities most conducive to maintaining good physical health. Determine how leisure and recreational activities and the option to engage in recreational activities are related to mental and physical health. Attempt to develop standards and criteria for the degrees and types related to both mental and physical health	-03

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SUBELEMENT #TITLE

20906 PLANNING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
	SYSTEMS TO IDENT. INDIVID. PREFERENCE (Issue included in 2090101)	-01,-11
	LEISURE/REC TIME REQUIREMENTS (Issue included in 2090101)	-02
	LEISURE/REC GROUND RESPONSIBILITIES (Issue included in 2090402)	-03
	LEISURE/REC AND EQUIPMENT PLANS (Issue included in 2090102)	-04
	LEISURE/REC REPAIRS/BACK-UPS (Issue included in 303 issues)	-05
2090602	SURPRISE ACTIVITIES What types are possible and have the greatest positive effect?	-06
	ADDING NEW LEISURE/REC ACTIVITIES (Issue included in 2090101)	-07
	LEISURE/REC EQUIP DESIGN REQUIREMENT (Issue included in 2090102)	-08
	PLANNING LEISURE/REC EQUIP. STORAGE (Issue included in 2090102)	-09
	NON-DEDICATED RECREATIONAL EQUIPMENT (Issue included in 2090304)	-10

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SUBELEMENT #

21001

TITLE

BODY-WASTE MANAGEMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2100101	COMMODE DESIGN REQUIREMENTS Develop design requirements from concept studies. Evaluate: locations, cleaning, and maintenance; contamination/odor control, and design impacts.	-02,-09
2100102	URINAL DESIGN REQUIREMENTS Develop design requirements from concept studies. Evaluate: cleaning & maintenance; contamination/odor control, and design impacts.	-02,-09
2100103	BODY WASTE HANDLING Develop criteria for stowage, processing & handling/disposal of body waste. Re: Commode/urinal system designs.	-09
2100104	NUMBER & LOC. OF COMMODE/URINAL UNITS Develop criteria for number and location of units. Impacts crew size; interior layout/arrangement, etc.	-03

SUBELEMENT #

21002

TITLE

WHOLE-BODY CLEANING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2100201	SHOWER UNIT DESIGN REQUIREMENTS Develop standardized criteria for international crew use of shower unit design; eg., size, configuration, flow and drain control, water temp. control (range, mix, auto/pre-set/manual); containment & air flow control and temp. Consider restraints, fixtures, soaping, anthropometrics. Include cleaning & maintenance; setup and stowage of gear; compartment interface.	-01
2100202	SHOWER USE REQUIREMENTS Assess water volume requirements, assessing shower frequency & durations, etc., considering international crew. Drives design of water system, recycling needs, etc. Include criteria for number of shower units.	-07
2100203	BODY DRYING AFTER SHOWERING Evaluate concepts for whole-body drying. Consider international crew preferences, volume, location, compartment, in/out of shower stall, etc. Develop design requirements.	-03

FORMAT 5 .

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
21003

TITLE
PARTIAL-BODY CLEANING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2100301	PARTIAL-BODY CLEANING RQMTS Evaluate partial-body cleaning needs & concepts for firm requirements, eg., hand wash, body wipe, wet/dry. Assess crew preference, sizing, water flow/contaminant, temp. control, location criteria; use restraint & access; clean-up & maint., contamination control. Include drying needs & provision rqmts.	-01,-03,-07

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PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

21004

TITLE

BODY GROOMING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2100401	BODY GROOMING REQUIREMENTS	-05
	Develop personal grooming requirements	
	to evaluate concepts, eg, shavers, tooth	
	brushes, hair-care, etc. Consider	
	international crew preference and com-	
	patibility & design provisions, re:	
	environment, interior arrangement,	
	handling, trash management, com-	
	patibility.	

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

21101 MENU

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2110101	MENU SELECTION Develop menu selection criteria for hot/cold, taste, nutrition, appearance, 0-g environ, etc: consider international population. Consider crew preference adjustments. Trade against provision capabilities, re: packaging, dispensing, handling, stowage, etc.	-01,-03
2110102	SNACKS/BEVERAGES SELECTION Develop requirements for snacks/ beverages based on preferences, crew options, nutrition, hot/cold, etc. Evaluate against capabilities and effects on design, eg., stowage, dispensing, packaging, etc.	-04

<u>SUBELEMENT #</u>	<u>TITLE</u>
21103	FOOD PACKAGING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2110301	INDIVIDUAL VS. BULK FOOD PACKAGE REQMTS Develop food packing concepts based on technology & ease of use/access, food types/menu; preparation; serving & dispensing; waste management. Evaluate individual vs bulk packaging.	-05, 21104-01,-02
2110302	AUTOMATIC FOOD INVENTORY SYSTEM Evaluate techniques for tracking food inventory-stores, stowage, consumption; types; meals & snacks, beverage. Develop requirements for system to minimize im- pact on operations.	-06

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT # TITLE
21105 FOOD PREPARATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2110501	FOOD HEATING METHODS Evaluate food heating/preparation methods, re: technology, packaging, crew performance/menu, design impacts, handling, safety, etc.	-01

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

21106 FOOD SERVING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2110601	ZERO-G FOOD CONTAINER/UTENSIL DESIGN Develop food serving utensil design rqmts re: handling, ease of use, stowage, cleaning, crew preference, etc, and interface with galley design concepts.	-01,-02

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

21107 FOOD CLEAN-UP

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2110701	REUSABLE FOOD SERVING COMPONENTS Develop disposable vs reusable concepts for food serving/cleanup requirements. Consider impacts on design factors, handling, etc. Impacts waste management, power, contamination/hygiene, etc.	-01,-02

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

21108 POTABLE WATER

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2110801	METHOD OF HEATING OR COOLING WATER Evaluate water heating/cooling concepts to evolve requirements. Consider technology, handling, design impacts, crew preference/needs, etc.	-02

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
21202

TITLE
CLEANING EQUIPMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2120201	CLEANING MATERIALS Study to develop criteria for cleaning liquids, materials, equipment. Re: O-g handling, off-gassing, hazards/safety, effectiveness, volume, etc.	-03
2120202	HOUSEKEEPING EQUIPMENT Evolve requirements for design of cleaning equip. eg., vacuum, filters, special gear. Relates to power, weight OPS impact etc. Includes cleanup techniques evaluation.	-05,-06

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PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

21205

TITLE

CLOTHES WASHER/DRYER

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2120501	WASHER/DRYER DESIGN Develop laundry load model to drive capacity requirements. Study for water needs; detergent selection & impact on ECLSS.	-03,-05,-06, -07,-08

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

21206

TITLE

DISHWASHER

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2120601	DISHWASHER DESIGN Develop specific rqmts for dishwasher design and alternatives for related design compatibility, eg., detergents, dish design & material, power, ECLSS impact, etc.	-01,-02,-03

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
21207

TITLE
GROWTH

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2120701	HOUSEKEEPING EQUIP- GROWTH REQMTS Review capacity/load requirements against growth variables to assess impacts. Trade equipment replacement against additional units; impacts on ECLSS re: detergents, cleaning materials, etc. Includes dishwasher, vacuum, clothes cleaning & support equipment.	-01, 21107-02

SUBELEMENT #

21301

TITLE

WASTE/TRASH GENERATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2130101	WASTE/TRASH PREDICTION MODEL Develop model to estimate volume and characteristics of waste/trash generation, based on mission activities, crew, environment, and station design features. Characteristics, e.g., hazardous, pathogenic, radioactive, toxic, dry, etc. Account for growth prediction.	-01,-02,-04, -05,21308-01, 21303-04

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
21302

TITLE
WASTE/TRASH COLLECTION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2130201	WASTE/TRASH MONITORING Develop methods for monitoring waste and trash from generation through handling and final disposal; i.e., trash inventory control.	-12
2130202	WASTE/TRASH COLLECTION METHODS Develop criteria/requirements for trash collection and control to drive design for collection, separation, handling, and disposal. eg., container designs, volume; liner characteristics, environmental criteria; toxic, hazardous control.	-02,-03,-04, -05,-07, 21303-01,-02, -04

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
21304

TITLE
MICROBIAL STABILIZATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2130401	MICROBIAL STABILIZATION TECHNIQUE(S) Develop alternative approaches for microbial stabilization techniques, e.g., vacuum dessication, diocides, freezing, etc. Evaluate options against control loading requirements; impacts on design considerations - volume, power, etc., handling & operations impacts.	-01,-02,-03

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
21305

TITLE
WASTE/TRASH TRANSFER

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2130501	WASTE/TRASH TRANSFER EQUIPMENT Develop alternative approaches for waste/trash transfer handling equipment design, e.g., automated vs manual; between modules, intra-module; STS to space station; airlock transfer; to logistics module.	-01

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
21306

TITLE
VOLUME REDUCTION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2130601	TRASH COMPACTOR REQUIREMENTS Develop alternative trash compactor requirements for volume, weight, power, duty cycle, compaction ration, etc. Assess quantity & location needs. Perform trades for alternative approaches: & to develop design criteria.	-01,-04

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

21307

TITLE

TRASH DISPOSAL

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2130701	CONTINGENCY TRASH DISPOSAL METHOD Assess alternative methods & design requirements for contingency trash disposal, e.g., space ejection or jettison to earth for inceneration. Assess need for design provision vs impact design, etc.	-02

SUBELEMENT # TITLE
21401 RESUPPLY REQUIREMENTS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2140101	SPARES COMPATIBILITY W/SS SYSTEM Space Station spares (ORU's) are TBD. Not only must they be justified from both the mission availability and on-board stockage standpoint, they must also satisfy such considerations as astronaut application, interchangea- bility, transport limitations (mass, volume), functional environment, and re-entry stresses (if ground refurbish- ment is intended).	-03
2140102	MODULE DOCKING AIDS Resupply missions of the Logistics Module and addition of new modules will be a periodic event over the life of the program. The docking phase is in- herently hazardous and currently is planned to be under astronaut control, rather than from the ground or auto- matically. Probably no single astronaut will perform this task more than 2 or 3 times, and at 90-day intervals the retained experience will be minimal. The crew, therefore, will need the best, safest and most effective docking aids and procedures possible. This will re- quire extensive analysis, verification thru simulation, and training.	-05

SUBELEMENT #	TITLE
21402	INVENTORY MANAGEMENT AND CONTROL

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2140201	INVENTORY MANAGEMENT SYSTEM DEVELOPMENT The scope, character and presentation of maintenance data, onboard stockage activities and location, tracking information, etc., are TBD and will require extensive analysis. Accuracy and speed will be paramount, and the system must be comprehensive, compatible with crew capabilities, efficient, and easy to update. Innovative techniques such as video consultation with ground specialists should be exploited. Uplink accommodation will require coordination with communication designers. The format used for output of inventory data is TBD. It must be clear, concise, accurate in description, and specific. To facilitate immediate crew recognition it should be in the exact terminology as used by the crew. To avoid equivocation and confusion, each item must be uniquely identified by a standard term universally understood and accepted. Due to possible interpretation as quantity, numbers should not be used as identifiers.	-01,-04 -02
2140202	LOCATION OF ON-BOARD SPARES On-board location of ORU storage is TBD and will require careful analysis to establish. Spares retrieval at time of need must be precise and fast, and availability of the required article must be immediately confirmable. The inventory management system must be structured to include specific indication as to where the resource is located, and the location itself must be easily accessible by the crew. Location/distribution of spares should be such that safe haven "retreat" will not result in a specific spare or spare item being unavailable/unretrievable.	-06

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

21407

PRESERVATION, PACKING & PACKAGING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2140701	<p>PACKAGING CONCEPTS</p> <p>Materials packaging for use and storage in the Space Station is not clearly defined. Experience on manned missions to date will be applicable, but further thought should be given to methods which will economize on weight and space, yet provide adequate protection against environmental influences including dynamic landing stresses. A Space Station-unique packaging specification must be developed. Materials which could float around (e.g., "worms") or outgas (e.g., "bubble"-pack) must be avoided.</p>	-04,-05

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
21501

TITLE
FOOT RESTRAINTS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2150101	STANDARDIZED FOOTWEAR/FOOT RESTRAINT SYS A study effort is required to produce a standardized space station IVA footwear/foot restraint system set of requirements based on the identified functional rqmts. Feasibility of a single standard design must also be evaluated.	-02,-06

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
21502

TITLE
BODY RESTRAINTS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2150201	BODY RESTRAINTS Need a standardized body restraint for IVA use throughout the space station for situations requiring stability in addition to that provided by foot restraints alone. Study is needed to evolve a firm set of requirements.	-05

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
21503

TITLE
EQUIPMENT RESTRAINTS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2150301	CABLE AND HOSE MANAGEMENT SYSTEM A development effort is required to provide a standard management system for temporary cables, i.e., extension cords, and hoses aboard the space station.	-03
2150302	EQUIPMENT RESTRAINT Standardized design criteria is needed for restraining & local handling of equipment throughout station, eg, food, galley, data files, recreation, leisure, stowage container internal restraint, includes refrigerator & freezer.	-07

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

21505

TITLE

PORTABLE RESTRAINTS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2150501	CREW PORTABLE RESTRAINT SYSTEM Common portable system needed to adapt to all non workstation/activity locations throughout station, e.g., for unusual maintenance. Study needed to develop requirements/criteria for restraint system and station interior structure to accommodate IVA and contingency EMU-suited activities.	-01

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
21601

TITLE
INSTALLED EQUIPMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2160101	CREW TRANSLATION AIDS Reported problems include handling of small items relative to use of mobility aids & restraints. Study is needed to clearly assess problem & to develop comprehensive criteria for translation aids with and without parts and equipment handling.	-04
2160102	INADVERTENT IMPACT PROTECTION Full implementation of this requirement might be difficult, costly & inappropriate. Provision of optimized translation & handling aids, good traffic path/flow design, and special guards might preclude impact sufficiently to preclude the need for this requirement.	-03

PROBLEMS/ISSUE IDENTIFICATION

TITLE
PORTABLE GEAR

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2160201	CONTAINMENT & TRANSLATION OF EQUIPMENT Resupply items which will be handled by the flight crew must be designed and packaged such that they do not exceed [TBD] dimensions in the handling con- figuration. An analysis of on-board capabilities and limitations will be needed to establish these TBD parameters.	-04

SUBELEMENT #TITLE

21802

Condition Verification

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2180201	QA ON-ORBIT VERIFICATION REQMTS Perform an analysis and assessment of the planned Space Station on-orbit activities to identify the requirements for performance of QA tasks (frequency, type, etc.)	-02c
2180202	QA VERIFICATION TOOLS AND EQUIPMENT Determine the verification tools and equipment required to accomplish QA functions on orbit. Determine the division between tools that are part of the Space Station system and those that are essentially carry-on. Determine the functional interfaces with and the services that must be provided by the Space Station. Includes measurement, nondestructive and destructive examination, etc.	-01a,-01j
2180203	FLUID SYSTEM VERIFICATION Determine the requirements, if any, for accessing and sampling contents of fluid systems, including crew consumables, coolant fluids, and propellant systems. Determine the requirement for fluid analysis. Determine the design requirements for Space Station fluid systems, stowage systems, spacecraft services (power, etc.) to enable the verification task. Includes bacterial and chemical aspects.	-01d
2180204	FRACTURE CONTROL PARTS INSPECT. CRITERIA Determine the constraints imposed on the inspection of "fracture control" parts (Ref. JSC 19649, Space Station Fracture Control Plan, April, 1984) by the limitations on inspection capability for parts (both internal and external to habitable volumes) that are to be deployed in orbit for extended periods.	-01k

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

21803 CONTROL

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2180301	ON-ORBIT FLUID SYSTEM CONTAM. CONTROL Determine the method to be employed to verify the integrity of fluid connection made on-orbit. The method should not contribute to environmental contamination and should be effective in determining connection integrity before introduction of fluids into the affected volume of the fluid system.	-05
2180302	EQUIPMENT STATUS MARKING ON-ORBIT Develop an approach to physically identify parts or equipment on-orbit to indicate such things as discrepant parts of systems, calibration/certification status, and equipment integrity.	-01a

<u>SUBELEMENT #</u>	<u>TITLE</u>
21804	EQUIPMENT CALIBRATION/CERTIFICATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2180401	ON-ORBIT SYSTEM CERTIFICATION REQMTS. Establish, through analysis and evaluation of requirements used to protect personnel and equipment in Earth-based facilities, the equipment and procedures required to certify for continued use such systems as fire suppression storage and dispensing, high and low pressure oxygen storage and distribution, coolant fluid storage and circulation, high pressure nitrogen storage and circulation, and fuel storage and distribution; components such as hatch seals; and equipment such as space suits or MMU's. Develop the detailed design requirements for spacecraft systems and for ancillary systems considering the limitations for performing the certification on-orbit.	-03 21802-01c,-01j (partial)

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

21805 ANOMALY INVESTIGATION, ANALYSIS & EVALUATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2180501	ON-ORBIT PROBLEM REPORTING (PRACA) SYS Develop the on-orbit and ground-based functional and organizational reqmts for PRACA during the Space Station mission. Include reporting of software problems.	-01,-02,-03

SUBELEMENT # TITLE
 21806 REPORTING AND RECORDING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2180601	ON-ORBIT CONFIGURATION MODS VERIFICATION Develop the reqmts and procedures that will be used to record and control changes made on-orbit to the spacecraft configuration throughout the life of the program. Include engineering directed changes as well as changes caused by malfunctions or operational workarounds.	-01
2180602	ON-ORBIT QUALITY ASSURANCE RECORDS Determine an approach to recording and reporting quality assurance data on- orbit, including types of records, methods of reporting, storage and recall requirements, etc.	-02

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

21807 DETECTION, ISOLATION, AND IDENTIFICATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2180701	HABITABLE VOLUME LEAK POINT LOCATION	-01
	Determine an effective method, including	
	system and support equipment design	
	requirements, for determining the	
	precise location of a leak in the	
	pressure membrane or at a sealing sur-	
	face for the habitable volumes of the	
	spacecraft while in orbit.	

SUBELEMENT #TITLE

21901

IV CLOTHING (UNDERWEAR AND OUTERWEAR)

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2190101	IV UNDERGARMENT DESIGN Material selection driven by requirements established for safety, color, weight, fiber properties, and fabric construction; trade-offs between GFE, custom-fitted, off-the-shelf and personal clothing; physiological changes; closures types/positions, sizing range, garment configurations; trade-offs between disposable or cleanable clothing or combination of alternatives; frequency of change and special handling for garments.	-02,-03,-04,-05,-06,-07,-08,-09,-10
2190102	IV OUTERGARMENT DESIGN Material selection driven by requirements established for safety, color, weight, fiber properties, and fabric construction; trade-offs between GFE, custom-fitted, off-the-shelf, and personal clothing sources; includes design features, adjustments, sizing range; trade-offs between disposable or cleanable or combination of alternatives. Crew shall be allowed to help design their clothing.	-04,-05,-09

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

22001 VIBRATION CONTROL

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
2200101	EQUIPMENT VIBRATION/MOUNTING STANDARDS Equipment vibration and mounting standards have not been established for Zero-g operation. Conventional standards developed for one-g type missions may not be applicable to keep structure vibration within limits.	-01,-02

SUBELEMENT #

30101

TITLE

TRAINING METHODS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3010101	DEPTH OF SYSTEM FUNCTION TRAINING Technological advancements in the space station will require that new decisions be made relative to the level of system function conceptual knowledge needed by the crew in order to support the maintenance & operations of the space station.	-01
3010102	SELF-MANAGED TRAINING Advances in training technology such as intelligent computer-aid instruction (ICAI) and intelligent tutors may provide a feasible training method alternative feasibility study is needed.	-04
3010103	ON-ORBIT OJT TRAINING COST & BENEFITS The cost & effectiveness of training on-orbit could be influenced by several factors, e.g., automated training costs (ICAI), the cost of the time available for training, the cost of human supervision & evaluation.	-05

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
30102

TITLE
TRAINING DEVICES AND MEDIA

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3010201	SIMULATION FIDELITY FOR ALL TRAINING Reduced fidelity simulation impacts cost, training quality, & performance quality. To approach the program goal of reduced training costs, a study is needed to determine minimally effective levels of simulation in various areas of training. Study must assess technology capabilities & feasibility of meeting determined minimal levels of performance.	-01,-02,-03

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
30103

TITLE
TRAINING LOCATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3010301	NON-CRITICAL TASK TRAINING ON-ORBIT The efficacy and efficiency of what to train on-orbit is an issue which must be resolved through a cost-benefit analysis after design concepts are firm and a task analysis is complete.	-02

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

30104

TITLE

TRAINING LEVEL (AMOUNT)

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3010401	TRAINING PERFORMANCE CRITERIA The efficient operation of a Space Station requires a reduction in the current level of training for shuttle. However, severe reduction in training could seriously impact both the safety and efficiency of Space Station operation. The determination of the level of performance to be trained is critical.	-02
3010402	CRITICAL TASK CROSS-TRAINING A task analysis will determine the critical tasks for which cross training should be provided. The kind and amount of cross-training must be determined within the context of both the safe and efficient operation of the Space Station	-03
3010403	ON-ORBIT REFRESHER TRAINING The type & effectiveness of on-board refresher training that can be provided will depend to some extent on available technologies and time. At a minimum, procedures which can be practiced on-board will be developed.	-04

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

30105

TRAINING FOR ORGANIZATIONAL EFFECTIVENESS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3010501	SMALL GROUP SYSTEM An umbrella psychological training program will be developed to cover individual and group training, ground and crew interaction and incorporating international crew considerations; conflict resolution, etc.	-01,-02

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

30106

TRAINING FOR FAMILY SUPPORT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3010601	FAMILY SUPPORT METHODS A general program for training families in developing & maintaining support systems for themselves & other flight crew families will be created. Study is needed to develop such programs. Training program for support of crew members on-orbit is also needed.	-01

SUBELEMENT #TITLE

30301

ACCESSIBILITY

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3030101	SUITED IVA CONTINGENCY OPS In case of full or partial loss of pressure, a sealed compartment or module must be accessed for maint. Suited maintenance will have major impact on design for maint. criteria. Study impacts & trades to establish guidelines for maintainability design requirements & maintenance concepts. Also establish minimum pressurized environment for IVA maint. activities. (See also Issue #1040201)	-06
3030102	WALL ACCESS/REPAIR Access must be provided to all walls, bulkheads, hatches, & seals for inspection & repair. A design concept & impact study should be conducted for efficient equipment arrangement that allows rapid wall access/inspection.	-08
3030103	CRITICAL SYSTEM DEFINITION ORU replacements in critical systems should not require system shutdown. Analysis/study is needed to identify and/or establish clear criteria for critical systems.	-04

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
30304

TITLE
TESTABILITY/DIAGNOSTICS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3030401	RADIATION-DAMAGED PARTS REPLACEMENT What level of circuit modeling complexity should be done to plan for & assist on-board repair/replacement of damaged electronics? Study should develop damage prediction model.	-10

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

30305

ORU DEFINITION/CONFIGURATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3030501	CUSTOMER ORU DESIGN STDS Establish ORU design standards for the customer accommodation module to reduce repair times & specialized equip. & establish commonality & safety precautions against ORU experiment contents.	-03
3030502	LEVEL OF ORU Study to define the level in the equipment configuration as a replaceable unit (ORU). (In electronics the printed circuit board, drives equipment design, maintenance repair level, support equipment, etc.).	-22

SUBELEMENT #
30306

TITLE
MAINTAINABILITY AIDS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3030601	MAINTENANCE WORKSTATION Analyze the functional capabilities, location, required equipment, equipment configuration and scope of repair in- tended for the maint. repair station. Will determine design criteria for size configuration, containment/contamination control, heat protection, access, location, etc. Trade study also needed to determine number of stations, re: EVA equipment maintenance support.	-07,-08

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

30401

MAINTENANCE CONCEPT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3040101	MAINTENANCE WITHOUT SHUTDOWN It should be possible to perform maintenance on system components w/o crew inadvertently or by design shutting down the whole system. Study needed to develop criteria & design impact. ALSO SEE ISSUE 3030101	-04

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

30407

CUSTOMER TECHNICAL DOCUMENTATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3040701	CUSTOMER TECH DOCUMENTATION REQUIREMENTS	-03
	Requirements for maintenance, operations	
	& servicing of customer payloads need to	
	be defined regarding astronaut available	
	time, safety, maintenance practices,	
	etc.	

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
30501

TITLE
FUNCTIONAL/LIMITATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3050101	SUPPORT EQUIPMENT REDUNDANCY Redundancy & "backup" tools/support equipment are desired per Skylab ex- perience. Study is needed to develop guideline for extent & areas of redun- dancy as well as for backup needs.	-02

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

30502

COMMONALITY/STANDARDIZATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3050201	SUPPORT EQUIPMENT DESIGN STANDARDS Study of maintenance activities/tasks & working environment is needed to evolve support equipment (tools & handling gear) design criteria. Skylab experience indicates off-the-shelf designs are generally acceptable, but SS specific criteria for selection among available varieties (at least) is needed, in support of commonality objectives.	-04

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
30504

TITLE
LOCATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
=====	=====	=====
3050401	GROUPING OF ON-BOARD TOOLS Definition of the tools to be carried aboard the Space Station, and the most appropriate location for them, are TBD. Analyses should be performed to deter- mine best location(s) & consider other factors such as accessibility, composi- tion, arrangement & potential utility.	-01

SUBELEMENT # TITLE
 30601 DUTY CYCLES

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3060101	IVA/EVA TASKS AND LEARNING CURVE Determine time lines and learning curves for different types of space operational tasks with different types of equipment in the IVA and EVA modes.	-01
3060102	SHIFT OPTIONS Determine shift options. (This area is crucial for organization).	-09
3060103	MISSION LENGTH REQUIREMENT What is the maximum length desirable regarding considerations for physiological, psychological, system factors.	-19
3060104	VARIED CREW SCHEDULE MODELS Determine various schedule models for optimal crew effectiveness over mission durations.	-26
3060105	TASK PERFORMANCE ANALYSIS Determine performances relative to different types and sequences of tasks, breaks, etc. Establish acceptable performance rate windows and develop standards for task scheduling in terms of sequences and length.	-27
3060106	REC/LEISURE TIME REQUIREMENTS Determine the amount of time needed for exercise, rest and recreation time to maintain proper health, motivation and alertness for different types of people over different mission lengths.	-28
3060107	PRODUCTIVITY FACTORS What social and psychological factors are related to crew productivity relative to different scheduling patterns and in terms of different mission requirements, crew skill mix, task pattern and mix and mission length.	-29
3060108	REST BREAK REQUIREMENTS Determine the frequency and length of rest breaks as they are related to productivity.	-30
3060109	ON-BOARD TASK TRAINING TIME Determine the amount of time for refresher or training prior to various	-32

	tasks and relative to the frequency of task performance.	
3060110	TRAINING TIME EFFECTIVENESS Determine most time-effective training methods	-33
3060111	SHIFT EFFECTS ON PERFORMANCE Determine the effects of the use of shifts and non-shift schedules on alert- ness, fatigue, and error rates. (This includes circadian interference as well as loss of sleep due to the activities of awake crew members.	-34

ORIGINAL TABLE
OF POOR QUALITY

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

30602 JOB ROTATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3060201	IMPORT./ESSENT. SKILLS FOR JOB ROTATION Determine important, but not essential, and essential crew skills and training requirements that all crew members should have.	-07,-08
3060202	TRAINING METHODS FOR JOB ROTATION Develop training methods that will facilitate crew skill levels and maint- enance to facilitate job rotation.	-09
3060203	MENTAL TASKS DISTRIBUTION Develop methods for crews to assign menial tasks during flight. Prepare training methods to enhance methods for task distribution which will facilitate the group dynamics of each crew and lead to less problems.	-10

SUBELEMENT # TITLE

30603 SCHEDULING METHODS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3060301	FACTORS FOR WORK SCHEDULING Determine what categories and specific factors should be incorporated in scheduling crew activities. Consider crew impacts; diversification needs; physiological and stress factors; coverage of shopping list (misc. odd task) work. Also assess how to incorporate global planning needs at the task level. Assess duty times for payload & housekeeping operations. Determine sleep periods, including pre/post sleep operations. Assess workload distribution criteria across on-orbit duration.	-07,-10,-12,-16,-21,-25,30601-02,-07,-13
3060302	DEVELOP EXPERT SCHEDULING SYST. REQMTS. Develop requirements for a user friendly expert system for scheduling crew activities. Consider experience feedback and learning; programming techniques; ground vs station scheduling management roles; protocols for ground input and access; user time and impact on operations. Assess availability of expert system with determined requirements.	-02,-11,-13,-15,-17,-19,-22
3060303	PRE-MISSION PLANNING CREW INVOLVEMENT Determine the methods and systems for involving crews in pre-mission planning. Consider experience; experience/skill input; morale and task commitment; and interface with scheduling system.	-06
3060304	GROUND SUPPORT FOR LONG-RANGE PLANNING Aspects of ground support affect each of the work packages. To assure a fully comprehensive and integrated ground support/operations functional capability, it will be necessary to establish a strong and knowledgeable coordination agency having oversight of contractor activities in each technical area and directive authority to maintain compatibility among the individual approaches. Composition and representation within the agency are TBD, but establishment at Level B is recommended. An immediate objective of the agency would be to undertake the long-range planning noted in Requirement 21406-01 and establish basic ground rules and	-01,-02

guidelines to be followed by all
elements involved in ground support
activities. The agency and its initial
output (suggested above) should be in
being by SDR (86/09/01).

SUBELEMENT #TITLE

30801

ORGANIZATIONAL STRUCTURE

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
=====	=====	=====
3080101	ORGANIZATIONAL STRUCTURE	-18
	Determine principles for the development of flight and ground organizational structures.	
	Determine best organizational systems to facilitate open and clear communication between ground and on-orbit crews.	-21
	Determine organizational methods for facilitating crew autonomy.	-23
	Determine method and policy for insuring on-board authority recognition and support in nominal and emergency situations. There should be provisions for the emergence of informal organizational structures which will be supportive of the formal structure.	-24
	Determine a clear definition of emergency situation chain of command for both ground and on-orbit crews.	
3080102	CREW CAREER OPTIONS	-19
	Determine career path for Space Station personnel and the methods by which flight experience will be related to careers	
3080103	P. I. ROLE	-25
	Determine the role and method of involvement of earth-based principal investigators in flight experiment decisions.	

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

30802

METHODS TO ENHANCE COMPATIBILITY

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3080201	METHODS TO ENHANCE CREW TEAMWORK Determine systems to select, identify and foster compatibility among crew members and with ground crews. Research and determine what compatible traits are, effect, etc. Determine the best methods and process for selection for a long mission in a confined and isolated environment. Develop a criteria and selection and assignment process which determines crews who meet the required skills, experience, health, education, knowledge, compatibility factors and teamwork. (Non-obtrusive).	-06
3080202	DECISION MAKING TECHNIQUES Determine an appropriate model for management, decision making, conflicts.	-01
3080203	CREW FEEDBACK Determine and develop a process acceptable to crews to collect feedback on which types of systems and training programs are most effective in flight. Determine the best feedback method to identify the most effective selection criteria and methods.	-11
3080204	AIR-TO-GROUND PROBLEM RESOLUTION Develop a system to provide flight crews with management and conflict resolution support.	-01
3080205	CREW PARTICIPATION IN ORG. DEVELOPMENT Determine the degree to which crews should participate in the development of the organizational structure to be used on their flights.	-06,-11

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
30803

TITLE
CREW SELECTION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3080301	CREW TEAMWORK EFFECTIVENESS Determine the best methods for observing crew effectively to insure crew compati- bility.	-03

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

30901 AUTONOMY

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
3090101	AUTONOMY TECH SELECTION/TIME PHASING Selection of technologies to be implemented to accomplish autonomy. Define time phasing for implementation of autonomy technologies. Define the degree of autonomy to be achieved (initially, growth).	-01
3090102	ON-ORBIT VS. GROUND TASK ASSIGNMENT Establish time phasing of Space Station tasks.	-05a,30603-02
3090103	ON-ORBIT VS GRD OFF-NOMINAL ACT PROTOCOL Protocols for dealing with off-nominal activities.	-06b

<u>SUBELEMENT #</u>	<u>TITLE</u>
40102	WORK STATION GENERAL REQUIREMENTS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
=====	=====	=====
4010201	WORKSTATION DESIGN GUIDELINES Design general guidelines for Space Station workstation.	-01g,-02a,-02b -02c,-03a-e, -04a-e
4010202	TASK VERIFICATION AT WORKSTATIONS The use of concept of independent obser- vation to verify the correctness of completion of procedures runs counter to such assumptions as "operation from a single eye reference point" which is discussed in Element 401. A study must be completed of the advantages of en- abling an independent observation of the performance of critical procedures against the weight, volume, or other configuration impacts caused on work- station design requirements. The results of the study will determine whether the concept of independent observation is viable, or whether equip- ment designs and procedure development should be oriented toward reliance on the operator for assuring correctness of procedural sequences.	21801-02c

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

<u>SUBELEMENT #</u>	<u>TITLE</u>
40104	PORTABLE WORKSTATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
4010401	PORTABLE WORKSTATION CONFIGURATION	-07
	Determine quantity and configuration of	
	the portable workstation. Include	
	stowage and mechanical/electrical/	
	data management system interfaces.	

GROUP 5 ISSUES

The Issues in this Group are marked "Preliminary". As noted in the Subelements List, Issues (and Requirements) were not prepared for all identified IVA/EVA Interface Elements. Full coordination with the Advanced EVA Systems studies (on RFP 9BE2-72-4-37P)*, which would provide significant contributions to this section, was not accomplished. The enclosed Issues, therefore, represent an incomplete and preliminary version of identified study needs only.

*Studies awarded to: Grumman Aerospace Corporation
 Boeing Aerospace Company
 McDonnell Douglas Technical Services Company, Inc.

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
50101

TITLE
SYSTEMS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5010101	RESIZING VOLUME The definition of the volume required to resize an EMU on-orbit & the equip- ment to support this activity needs to be studied.	-04
5010102	EQUIPMENT AIRLOCK LOCATION The optimum location and size of the scientific airlocks needs to be studied. Assessment of the types of equipment & location on the station need to be considered.	-07

PRELIMINARY

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
50103

TITLE
HYBERBARIC

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5010301	WASTE MANAGEMENT, HYPERBARIC The accumulation of wastes & the duration of the crewmembers stay in the hyperbaric facility needs to be studied to determine waste handling requirements	-03
5010302	HYPERBARIC COMMUNICATION SYSTEM The needs for an audio-visual communication system for the Hyperbaric chamber should be studied. Evaluate downlink/uplink with ground personnel and communication with Space Station crew, with special consideration to the HMF. Study will provide specific requirements.	-05

PRELIMINARY

SUBELEMENT #
50104

TITLE
EVA SUPPORT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5010401	SUIT REPAIR LOCATION The location of the EMU suit repairs needs to be determined to ensure the types of equipment and work volumes needed to support these tasks.	-11
5010402	EQUIPMENT AIRLOCK LOCATION The optimum location & dimensions of the equipment airlock to accommodate the transfer of the different types of EVA equipment & ORU's on-orbit needs to be studied.	-14
5010403	DISPLAY/STATUS CONTROL Each airlock hatch will have the capability of displaying the current airlock configuration & allow control from either side of a hatch. Optimum display/lighting techniques & EMU operation need to be studied. Requirements for safe interlock control of hatch locks must be developed.	-17
5010404	PRESSURE CONTROLS The pressurization/depressurization controls on the airlock should be controlled by a single EMU suited hand. Design requirements must be developed, considering control & viewing constraints.	-18
5010405	AIRLOCK SOUND LEVELS Predicted and upper limit criteria sound levels of the airlock during pressurization/depressurization need to be determined.	-32

PRELIMINARY

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

50401

STOWAGE OF EMU EQUIPMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5040101	EMU STOWAGE REQUIREMENTS Study is needed to assess requirements for locations and methods of EMU stowage. EMU drying & cleaning, access, servicing requirements, and resizing for donning must be considered.	-07

PRELIMINARY

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
50402

TITLE
EEU EQUIPMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5040201	EEU EQUIPMENT STOWAGE Determine location and method of EEU equipment stowage. Also determine the method of accessing the EEU outside the airlock. Consider pre/post use opera- tional check out requirements, and meteorite/debris protection.	-08

PRELIMINARY

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

50403

RESTRAINTS/TETHERS/EVA TOOLS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5040301	STOWAGE OF EVA RESTRAINTS/TETHERS/TOOLS Determine locations, volume requirements, layout, access design, and identification of stowage compartments.	-04

PRELIMINARY

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

50404

EMU/EEU SERVICING & CHECKOUT EQPT. STORAGE

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5040401	STOWAGE OF EMU/EEU SERVICING EQUIPMENT Determine locations, volumes, layout, design, access and identification of EMU/EEU equipment & storage containers.	-04

PRELIMINARY

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

50405

MAINTENANCE & REPLACEMENT PARTS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5040501	STOWAGE OF EVA SPARES TOOLS Determine locations, volumes, design identification, and restraints for stowage compartments which contain spare parts and maintenance tools for EVA support.	-04

PRELIMINARY

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

50406

PAYLOAD SUPPORT EQUIPMENT STOWAGE

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5040601	STOWAGE OF PAYLOAD SUPPORT EQUIPMENT Determine volumes, layout, design standards, restraints, & identification methods for storage containers which will house payload support equipment.	-05

PRELIMINARY

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
50407

TITLE
GROWTH

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5040701	GROWTH OF EVA SUPPORT STOWAGE Assess volume requirements for growth vs. Space Station volume constraints; determine best method of expanding initial stowage compartments.	-01

PRELIMINARY

<u>SUBELEMENT #</u>	<u>TITLE</u>
50601	IN-SUIT BODY WASTE MANAGEMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5060101	IN-SUIT URINE COLLECTION REQUIREMENTS Develop criteria for mobility and comfort; evaluate preventive contamination measures against crewmembers health risks; into breathing environment, dermal irritation and chafing; and acceptance of crew to installation, usage and handling of the urine collection device.	-05
5060102	EMU WASTE HANDLING SYSTEM Requirements for EMU waste handling should be based on design concept studies to evolve system criteria and requirements for handling & transferring waste to Space Station waste handling system.	-05

PRELIMINARY

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT # TITLE
 50602 SUIT HYGIENE

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
=====	=====	=====
5060201	SUIT HYGIENE CLEANING REQUIREMENTS Develop procedures for suit hygiene to minimize crew involvement, effort and time. Design requirements for a method of suit sterilization, biocidal wipe, UV or IR.	-04
5060202	SUIT HYGIENE EQUIPMENT REQUIRED Evaluate test equipment necessary for periodic suit checks; super sensitive pressure gauges, leak detectors, radiation level sensors, and breath air sensors; level of replacement to maintain the suit. Develop automatic suit drying equipment.	-04

PRELIMINARY

SUBELEMENT #TITLE

55101

GENERAL LAYOUT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
=====	=====	=====
5510101	MAN-TENDED VOLUME AND LAYOUT The interior volume and layout designs must be evaluated to develop requirements which accommodate EMU-suited activities within the enclosed environment. Significant access, visibility and volume constraints must be addressed and reflected to needs for lighting and controls placements. Potential growth & reconfiguration should be considered.	-05,-14,-18
5510102	MAN-TENDED MAINTENANCE REQUIREMENTS Study is needed to develop the maintenance concepts and to determine the equipment & facilities required for the man-tended module. Address payloads, fixed equipment/systems and module as configured.	-19

PRELIMINARY

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
55102

TITLE
TRAFFIC FLOW

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5510201	MAN-TENDED WORKSTATION LOCATIONS Based on the defined nature & quantity of workstations, requirements should be developed for locations. EMU activi- ties, number of crewmembers, etc., should be considered for man-tended operations.	-07

PRELIMINARY

SUBELEMENT #

TITLE

55103 DECOR

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
=====	=====	=====
5510301	MAN-TENDED COORDINATES A coordinate location scheme should be developed for station internal and external areas. The scheme should be compatible with the scheme developed for the manned IOC station.	-01
5510302	MAN-TENDED EQUIPMENT LABELING Criteria must be developed for labeling and marking of all equipment within the man-tended module to ensure readability by EMU-suited crew. Consideration of lighting and positional constraints should be included.	-02

PRELIMINARY

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PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
55105

TITLE
ANTHROPOMETRY

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5510501	MAN-TENDED ANTHROPOMETRIC RANGE Study is needed to define the range of anthropometric dimensions appropriate for EMU-suited operations within the module. Movement dynamics, viewing & reading angles/distances, etc., should be considered.	-01

PRELIMINARY

SUBELEMENT #TITLE

55106 MODULARITY

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5510601	INTERIOR VOLUME REARRANGEMENT RQMT Determine requirements that define how EMU-suited crewmembers can modify interior volume arrangements to accommodate revised configurations. Determine equipment rack requirements that ensure flexibility to reconfigure in various module configurations.	-01,-08
5510602	STANDARD HARDWARE AND INTERFACE RQMTS Considering EMU-suited crewmembers, determine the requirements that define how interfaces between primary & secondary structure & between subsystems and their attachment to structure shall be standardized to minimize human involvement in repair, maintenance, reconfiguration etc. This includes standard electrical/cooling/data bus interfaces. Also included are determination of the commonality design requirements for fasteners, tools, latches, & packaging. Consider the station growth implications.	-02,-10, -11

PRELIMINARY

SUBELEMENT # TITLE
 55107 WINDOWS/REMOTE VIEWING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5510701	WINDOW CONFIG FOR 2 EMU-SUITED CREW VIEW Determine the window diameter and configuration required to provide for viewing and maintenance activities by 2 EMU-suited 95th percentile male crewmembers. Evaluate functional requirement for man-tended mode.	-03,-13
5510702	WINDOW MAINTENANCE AND PROTECTION REQMTS The degree of optical degradation due to exposure to ultra violet x-ray radiation, meteoroid impacting and/or contamination allowable and the means of cleaning, maintaining, repair and/or replacement and testing requires further study.	-17,-18
5510703	MAN-TENDED MODULE WINDOW SPECS In view of the man-tended mode where crewmember would be looking out of the windows while wearing an EMU helmet that has curved surfaces, filters, coatings, etc., determine the window filters, shielding, haze, light transmission, surface distortion, and parallelism specifications.	-04,-05, -06,-07
5510704	WINDOW VIEWING REQUIREMENTS Space Station viewing requires view in all directions, leading to multiple windows. Man-tended operations may not require similar view; the STS may supplement experiment and viewing capabilities. Assessment should be made to derive window view requirements for the man-tended module.	-14

PRELIMINARY

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

55109

STOWAGE/STORAGE

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5510901	MAN-TENDED STOWAGE VOLUME/LOCATION/TYPES	-10,-11
	Study is needed to determine types and volume of stowed items on the man-tended station. Stowage volume requirements should be defined according to types and locations, as well as environmental control criteria.	

PRELIMINARY

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT # TITLE
55201 INTERNAL ENVIRONMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5520101	PAYLOAD-CAUSED ATMOS & WATER CONTAM RQMT	-01
	Define the requirements, if any, for	
	payload-caused atmosphere and water	
	contamination detection, monitoring,	
	and control.	

PRELIMINARY

SUBELEMENT # TITLE
 55202 EXTERNAL ENVIRONMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5520201	MAN-TENDED RADIATION MONITORING SYSTEM Define the man-tended mode performance requirements for radiation dose monitoring systems. How many, what locations, & sensitivity ranges of internal fixed active radiation sensors & the requirements for read-out and data storage? Note that such area monitoring is required by law (10CFR203).	-01
5520202	MAN-TENDED PERSONNEL DOSIMETRY Define the man-tended mode performance requirements of personnel dose monitoring system. What radiation types, levels needed for read-out, and what type read-out and data management? Note that personnel monitoring of some kind is required by law (10CFR20.203)	-02
5520203	MAN-TENDED OPTIMAL SHIELDING DISTR For the EMU-suited man-tended mode, what is optimal distribution of radiation shielding mass? On vehicle structure, in equipment, personal shields in/on EMU, etc.?	-05,-08,-09,-10
5520204	MAN-TENDED WINDOW RADIATION PROTECTION For the EMU-suited man-tended mode, what attenuation factors are required in windows for ionizing radiation protection? What window materials, what allowable dose rates at window areas, consider trapped particles only. Involves allocation of dose rate requirements to activities in proximity to windows.	-03
5520205	SHIELDED STORAGE How much shielded volume, at what dose rates, is required?	-04
5520206	MAN-TENDED RADIOLOGICAL TRAINING For the man-tended mode, what is required level of crew radiological training? What curriculum, behavioral objectives,duration,evaluation methods?	-06
5520207	HZE PARTICLE PROTECTION FEASIBILITY - MT For the man-tended mode, is it feasible or useful to protect crew from HZE particles? To what levels of fractional	-11

PRELIMINARY

	cell lethality?	
5520208	MAN-TENDED SOLAR FLARE RISK For the man-tended mode, what is allowable risk due to solar flare radiation? This must be decided, & early on, since solar flare sizes are distributed statistically & risk cannot be zero, although it can be small. Amount/nature of shielding will depend upon the risk that is deemed acceptable. Acceptable probability of radiation illness syndrome probability of late effects - e.g., cancer?	-12
5520209	MAN-TENDED SOLAR FLARE PROTECTION For the man-tended mode, what is best way to protect crew from solar flare doses? Determine feasibility of safe haven shielded room.	-12
5520210	MAN-TENDED SOLAR FLARE CONTINGENCY PLNGG How extensive should solar flare contingency planning be for man-tended?	-13
5520211	MAN-TENDED SOLAR FLARE WARNING SYSTEM How extensive and reliable should solar flare warning system be for man-tended?	-13
5520212	MICROMETEORITE AND DEBRIS PROTECTION -MT For the man-tended mode, determine how best to coordinate radiation shield design with micrometeorite and debris shield design. Low-Z materials needed on exterior for electron shields. What commonality exists in protective measures and how to jointly optimize them?	-15
5520213	RAD SHIELDING STRATAGY FOR GROWTH - MT For the man-tended mode, define how best to provide growth capability for radiation environment? How construct shielding in orbit? Cost trades with different approaches?	-16

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SUBELEMENT # TITLE
 55203 INDUCED ENVIRONMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5520301	MAN-TENDED EM LEAKAGE SPECIFICATIONS What leakage/stray/scattered/accessible radiation intensities over the entire EM spectrum (3 Hz to UV) should be specified for all on-board electronic/optical equipment for man-tended mode?	-03
5520302	MAN-TENDED RF/MICROWAVE EXPOSURE LEVELS For the man-tended mode, what should be the allowable power density or E-/H-field exposure levels for Space Station crew? There is considerable controversy, and several sets of standards, by NASA, OSHA, ANSI, DOD, ACGIH, that have differing allowables. Space Station program will not resolve the controversy, but must choose some allowable (maximum) exposure for design.	-01
5520303	MAN-TENDED LASER LIGHT PROTECTION OPTION For the man-tended mode, what viable alternatives exist for crew eye/skin protection from Space Station or STS laser sources when the mission requires use of high-power lasers which can produce either direct or diffusely scattered radiation in the Space Station? Goggles? Face shields? Curtains? Consider effectiveness & inconvenience of use.	-04
5520304	SYNERGISTIC INDUCED ENVIRON EFFECTS -MT As the Station grows, what synergistic effects, e.g., effluents, debris, or radiation, are generated by the proximity of additional modules or systems?	-06

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<u>SUBELEMENT #</u>	<u>TITLE</u>
55204	AREA LIGHTING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
=====	=====	=====
5520401	MAN-TENDED LIGHTING REQUIREMENTS	-01A,-05
	For the EMU-helmeted man-tended mode,	-06,-07
	determine the needed general illumina-	
	tion lighting intensity; surface reflec-	
	tion percentages for walls & ceilings;	
	luminaire color temperature; & surface	
	temperature of lighting fixtures.	

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SUBELEMENT # TITLE
 55205 NOISE & VIBRATION

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
=====	=====	=====
5520501	EQUIPMENT NOISE & VIBRATION STANDARDS In an unpressurized man-tended module, noise, per se, is not an active con- sideration. Standards should be developed, however, based on noise/ vibration transmission to payloads, to station equipment, to crewmember in tactile contact and through docking connections to STS.	-01
5520502	EQUIPMENT INSTALLATION SPECS Develop mounting and location spec's to meet determined limit levels for equip- ment vibrations.	-02
5520503	EMU NOISE Perform analyses to assess all potential sources of noise for the EMU suited crewmember in the man-tended mode, e.g., EMI or vibration conduction.	-04

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PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

55206 CREW SAFETY

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5520601	MAN-TENDED EMERGENCY CONTROL Study is needed to define and develop safety criteria for feasible emergency conditions in the unpressurized man-tended mode. Adequate warning schemes are needed, e.g., EMU plug-in warning system or heavy reliance on visual system; high temperature surfaces (in lieu of fire) should be detected and alerted, etc.	-01

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PROBLEMS/ISSUE IDENTIFICATION

<u>SUBELEMENT #</u>	<u>TITLE</u>
55213	WASTE/TRASH MANAGEMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5521301	MAN-TENDED TRASH MANAGEMENT Study is needed to determine the nature and amount of trash that may be generated on board the man-tended module. Such trash may result from repair work, from payload spills, or other payload causes. Management schemes should then be developed.	-01

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SUBELEMENT #TITLE

55214 SUPPLY SUPPORT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5521401	SPARES COMPATIBILITY W/SS SYSTEM - MT For the man-tended mode, Space Station spares (ORU's) are TBD. Not only must they be justified from both the mission availability & on-board stockage standpoint, they must also satisfy such considerations as interchangeability, transport limitations (mass, volume), functional environment, and re-entry stresses (if ground refurbishment is intended).	-03
5521402	MAN-TENDED INVENTORY MANAGEMENT SYSTEM For the man-tended mode, the scope, character and presentation of maintenance data, onboard stockage activities & location, tracking information, etc., are TBD and will require extensive analysis. Accuracy & speed will be paramount, & the system must be comprehensive, efficient, and easy to update by EMU-suited crew. Innovative techniques such as video consultation with ground specialists should be exploited. Uplink accommodation will require coordination with communication designers. The format used for output of inventory data must be concise, accurate and specific, and in the exact terminology as used by the crew. To avoid error, each item must be uniquely identified by a standard universally understood term. Due to possible interpretation as quantity, numbers should be avoided as identifiers.	-08,-09,-11, -13
5521403	LOCATION OF ON-BOARD SPARES On-board location of ORU storage is TBD and will require careful analysis to establish. Spares retrieval at time of need must be precise and fast, and availability of the required article must be immediately confirmable. The Inventory Management System must be structured to include specific indication as to where the resource is located, and the location itself must be easily accessible by the crew. Location/distribution of spares should be such that safe haven "retreat" will not result in a specific spare or spare	-11

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	item being unavailable/unretrievable.	
5521404	PACKAGING CONCEPTS - MAN-TENDED MODE	-19,-25,-26
	For the man-tended mode, materials	
	packaging for use and storage in the	
	Space Station is not clearly defined.	
	Experience on manned missions to date	
	will be applicable, but further thought	
	should be given to methods which will	
	economize on weight and space, yet	
	provide adequate protection against	
	environmental influences including	
	dynamic landing stresses. A man-tended	
	Space Station-unique packaging specifi-	
	cation must be developed.	

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PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT # TITLE
 55215 RESTRAINT SYSTEMS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5521501	MAN-TENDED RESTRAINT SYSTEM A standardized restraint system must be developed for use within the unpresurized man-tended module. Evaluation of the current EVA restraint system is needed to ensure that it will satisfy the nominal and repair task requirements in the man-tended mode. The restraint system/EMU interface must be coordinated with the Space Station EMU development activity.	-02,-06,-13

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PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
55216

TITLE
MOBILITY AIDS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5521601	MAN-TENDED MOBILITY AIDS A standardized system of fixed and portable hand holds must be developed for use within the unpressurized man-tended module. Evaluation should consider the array of tasks, volumes and clearances to be imposed.	-03
5521602	MAN-TENDED RESUPPLY/PAYLOAD DIMENSIONS Standardized requirements for dimensions, configuration, and handling characteristics must be developed for resupply items and mission payloads for the man-tended mode. Requirements must accommodate EMU handling.	-07

PRELIMINARY

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PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT # TITLE
 55217 COMMUNICATIONS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5521701	MAN-TENDED COMM TO GROUND Study is needed to determine what communications links are required to the ground; then to assess requirements for comm provisions independent of the docked orbiter. Evaluate role of orbiter in supporting man-tended station comm requirements.	-14
5521702	MAN-TENDED C&T SYSTEM CONTROLS Man-tended crew will be EMU suited. Controls & displays, therefore, must accommodate the EMU gloved hand & visual restrictions. Study is needed to develop design requirements.	-06

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SUBELEMENT #
55301

TITLE
CREW TRAINING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5530101	DEPTH OF SYSTEM FUNCTION TRAINING Evaluation must be made relative to the level of system function conceptual knowledge needed by the crew in order to perform man-tended functions.	-01
5530102	SELF-MANAGED TRAINING Advances in training technology such as intelligent computer-aid instruction (ICAI) and intelligent tutors may provide a feasible training method. An alternative feasibility study is needed.	-04
5530103	SIMULATION FIDELITY FOR TRAINING Reduced fidelity simulation impacts cost, training quality, & performance quality. To approach the program goal of reduced training costs, a study is needed to determine minimally effective levels of simulation in various areas of training. Study must assess technology capabilities & feasibility of meeting determined minimal levels of performance.	-05, -06
5530104	TRAINING PERFORMANCE CRITERIA A more cost effective approach for operation of the man-tended station requires a reduction from the current level of training for shuttle. However severe reduction in training could seriously impact both the safety and efficiency of operation. The determination of the level of performance to be trained is critical.	-08

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PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #
55303

TITLE
MAINTAINABILITY

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5530301	SYSTEM SERVICE POINT LOCATIONS Fluid system service points, e.g., filling, draining, purging, bleeding must be accessible. Locations within the module, however, may introduce hazards. Study for design requirements is needed to ensure adequate system interfacing, EMU-suited accessibility and safety.	-04
5530302	PAYLOAD SEAL INTEGRITY Design requirements for payloads which must retain seal integrity is needed. Seals should be inspectable & acces- sible. Type of feasible repair activity must be determined. Impacts safety, tools, hardware design and safety.	-06

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SUBELEMENT #

TITLE

55304 MAINTENANCE

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5530401	MAN-TENDED MAINTENANCE CONCEPT A maintenance concept should be developed to define ORUs and nature of maintenance activities in light of defined "normal" man-tended functions. Concept should lead to definition of maintenance locations, e.g., within the station module or supported by shuttle. Maintenance requirements for the module system must also be defined (as differentiated from payloads.)	-02,-03
5530402	MAN-TENDED MAINTENANCE WORKSTATION Based on the results of the maintenance concept and unique EMU-suited environment, requirements for the design of the station maintenance workstation should be developed. Special consideration must be given to mobility, restraints, lighting, access, etc., within the unpressurized environment.	-04

PRELIMINARY

SUBELEMENT # TITLE
 55306 ACTIVITY PLANNING AND SCHEDULING

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5530601	EVA TASK TIMES AND LEARNING CURVE Determine time lines and learning curves for different types of space operational tasks with different types of equipment in the (EVA) man-tended modes.	-01
5530602	MAN-TENDED MISSION LENGTH REQUIREMENT What is the maximum length desirable regarding considerations for physiological, psychological, system factors.	-19
5530603	VARIED CREW SCHEDULE MODELS - MAN-TENDED Determine various schedule models for optimal crew effectiveness over mission durations.	-02,-13,-26
5530604	TASK PERFORMANCE ANALYSIS Determine performances relative to different types and sequences of tasks, breaks, etc. Establish acceptable performance rate windows and develop standards for task scheduling in terms of sequences and length.	-27
5530605	MAN TENDED LEISURE TIME REQUIREMENTS Determine the amount of time needed for exercise and rest time to maintain proper health, motivation & alertness for different types of people over different mission lengths.	-28
5530606	PRODUCTIVITY FACTORS What social and psychological factors are related to crew productivity relative to different scheduling patterns and in terms of different mission requirements, crew skill mix, task pattern and mix and mission length.	-29
5530607	MAN-TENDED REST BREAK REQUIREMENTS Determine the frequency and length of rest breaks as they are related to productivity.	-30
5530608	SHIFT EFFECTS ON PERFORMANCE -MAN-TENDED Determine the effects of the use of shifts and non-shift schedules on alertness, fatigue, and error rates. This includes circadian interference as well as loss of sleep due to the activities of awake crewmembers. Develop shift	-34

PRELIMINARY

	options.	
5530609	IMPORT./ESSENT. SKILLS FOR JOB ROTATION Determine important, but not essential, and essential crew skills and training requirements that all crew members should have in man-tended mode. Also assess methods for rotation of less- important but needed tasks - considering effects on morale & productivity.	-32,-33,-38
5530610	FACTORS FOR WORK SCHEDULING Determine what categories and specific factors should be incorporated in sche- duling crew activities. Consider crew impacts; diversification needs; physio- logical and stress factors; coverage of shopping list (misc. odd task) work. Also assess how to incorporate global planning needs at the task level.	-07,-22,-23, -24
5530611	PRE-MISSION PLANNING CREW INVOLVEMENT Determine the methods and systems for involving crews in pre-mission planning. Consider experience; experience/skill input; morale and task commitment; and interface with scheduling system.	-26,-29

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<u>SUBELEMENT #</u>	<u>TITLE</u>
55307	MAN-MACHINE ROLES

<u>ISSUE #</u>	<u>ISSUE TITLE</u>	<u>REQUIREMENT(S)</u>
5530701	MAN-TENDED INTERFACE CONTROLS Assuming EMU suited activities in the man-tended mode, design of displays & controls must accommodate this con- strained interface. Study is needed to assess impact on automated vs manual approaches & to develop appropriate display/control design requirements.	-17

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SUBELEMENT #

TITLE

55309 STATION AUTONOMY

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5530901	MAN-TENDED LEVEL OF AUTONOMY Selection of technologies to be implemented to accomplish autonomy on the man-tended station needs to be defined by trade study. The time phasing of technology implementation is to be defined. Define the degree of autonomy to be achieved at man-tended IOC during tended modes. Assess what functions must be externally controlled & how these will interact with tended periods.	-01,-02

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PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

55401 WORKSTATIONS

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5540101	EVA WORKSTATION DESIGN GUIDELINES The human engineering design standards for the EMU-suited crewmember workstations, both fixed and portable, need to be defined. Existing standards are inadequate.	-07,-08,-09
5540102	MAN TENDED OBSERVATORY The need for and the configuration of an observatory suitable for use by EMU-suited crewmen needs to be defined.	-15
5540103	MAN-TENDED MRMS WORKSTATION RQMTS The design requirements for the man-tended Remote Manipulator System control must be developed for EMU suited crew members.	-16

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PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT # TITLE
55402 DATA MANAGEMENT

ISSUE #	ISSUE TITLE	REQUIREMENT(S)
5540201	MAN TENDED DATA MANAGEMENT INTERFACE Requirements for data management should be developed for the man tended mode. Because of EMU suited operations inter- face with the system - operation and maintenance will be complex. Feasible interactions with the STS should be evaluated; also the role of conversion from automatic to manual-active modes during tended modes.	-02

PRELIMINARY

